

Abstract

The Internal Cracks' Influence on The Stress Behavior of Al₂O₃ Tribo-Mechanical System Under Contact Pressures [†]

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Abstract: Ceramic materials have properties such as: high hardness; high ratio between mechanical resistance/density, wear and corrosion resistance; high stability to the action of corrosive agents; and relatively low price. However, the use of technical ceramics has a rather limited area, determined essentially by its tribo-mechanical behavior. The machine parts may fail and not fulfill their functional role due to some limit factors. This paper is based on the behavior of aluminum ceramics in terms of stress and strain in the contact area, and the tribological behavior of these materials. A mathematical concept, including multi-objective optimization based on the cuckoo search algorithm of breaking ceramic materials in which there are defects in the form of internal cracks, has been developed. A defect criterion has been formulated to allow the evaluation of the propagation of the semicircular crack which shapes the places where there are natural defects in the ceramic mass. The model highlighted is the contact between two curved surfaces, specific to the ball–ring contact in the bearings. It has highlighted tensions stress and the stress factors, taking into account the coefficient of conformity and the influence of the friction effects. The experimental study of the mechanical stress state in the contact areas was carried out with the ceramic friction couple ball-bearing ring (Al₂O₃—99.7% with the addition of SiO₂, Fe₂O and MgO). A large number of experimental tests were performed. The results of this research work are useful for mechanical designers to identify the crack effect on mechanical parts' lifetime and to improve reliability.

Keywords: crack; pressure stress; tribosystem; alumina

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